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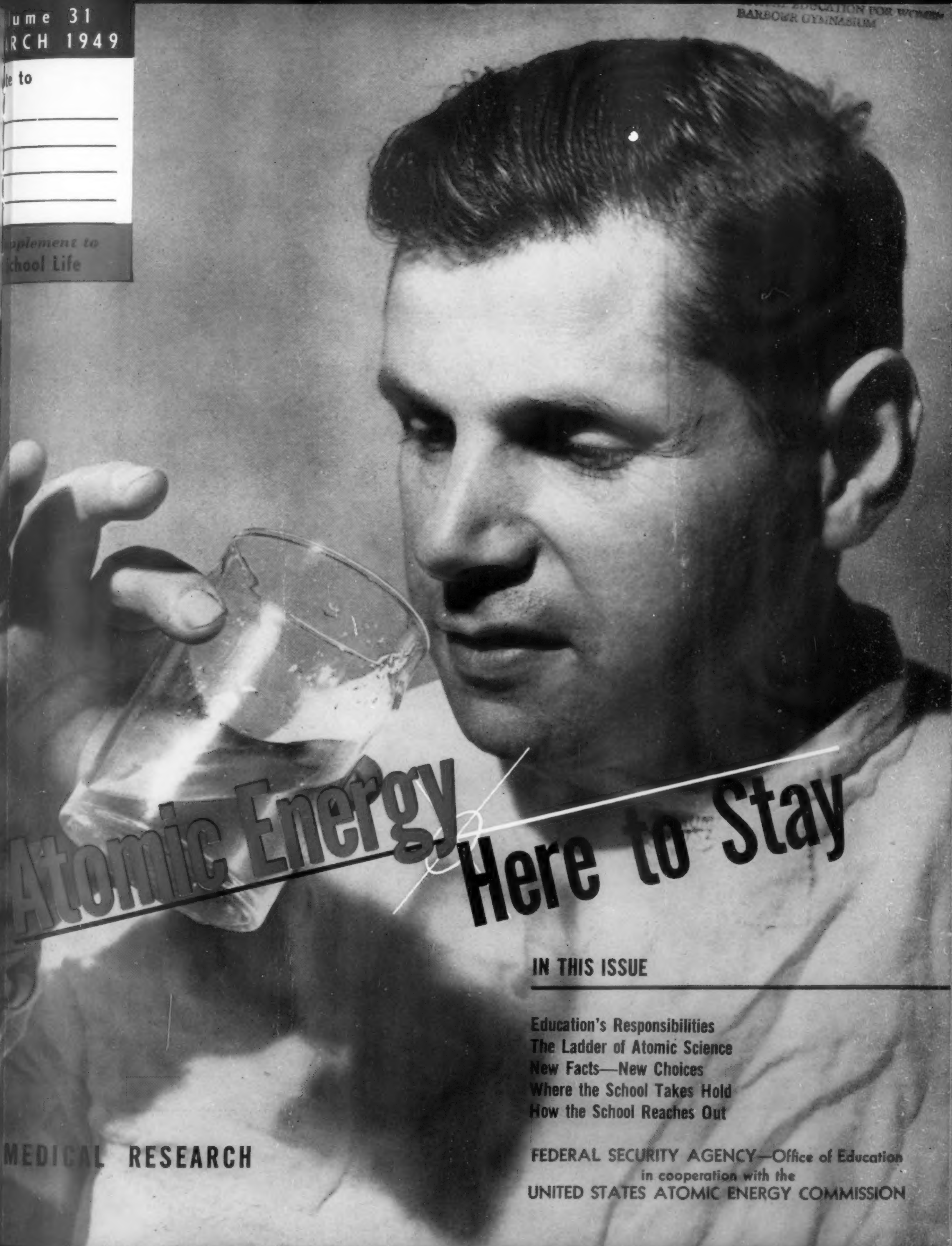

Atomic Energy Here to Stay

IN THIS ISSUE

MEDICAL RESEARCH

FEDERAL SECURITY AGENCY—Office of Education
in cooperation with the
UNITED STATES ATOMIC ENERGY COMMISSION

The Road Ahead

THE existence of the atomic bomb is both a physical and a political fact. Physically it has posed a whole new set of problems. Politically it has made crucial an age-old problem, namely, how to organize mankind for the outlawry of war; how to achieve an ordered peace with justice.

The schools and colleges of the United States do not operate in a social and political vacuum. Education must take account of new forces, whether they be physical, economic, social, or political, that affect mankind. The central implications of atomic energy are as much ethical as they are physical, as certainly political as they are economic. It remains for educators to realize those implications and to make them clear to the youth of America.

In order to assist the schools to find the information, and to know what other school systems are doing, the Office of Education formed in 1948 an Office-wide committee with the special mission of considering the implications of the development of atomic energy for the schools and colleges of this country. The committee felt that it was desirable to attempt to move "beyond the threshold of vagueness, into the area of creative planning and constructive action" in the interest of making atomic energy work for the benefit of mankind.

The present publication is one result of the work of the committee. In its preparation the committee has been aided by the consultants listed on this page. On behalf of the Office, I express appreciation to all those persons and the hope that this special issue of SCHOOL LIFE will serve in some small measure to chart the road that lies ahead.

Rall I. Grigsby

Acting U. S. Commissioner of Education.

Office of Education Committee on Educational Implications of Atomic Energy

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SCHOOL LIFE *is published each month from October through June by the Federal Security Agency, Office of Education, Washington 25, D. C.*

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Atomic Energy is Your Business

. . . *"the release of atomic energy on a large scale is practical . . . It is reasonable to anticipate . . . that this new source of energy will cause profound changes in our present way of life."*

ATOMIC ENERGY ACT OF 1946 (PUBLIC LAW 585, 79TH CONGRESS)

Education's Responsibilities

by David E. Lilienthal, Chairman, U. S. Atomic Energy Commission

• No undertaking is more critically important nor more urgently needed than the education of American youth in the basic facts and essential meanings of atomic energy.

The plain fact is that unless America's young people become informed about this new science, so that they can chart their own destiny in the years to come, then democracy in its very essentials will be gravely imperiled, not by the action of a foreign foe, but by default by those who benefit most from it.

This is a truth that becomes increasingly important with each passing day. Even at this early stage in the new age we are beginning to see that many important decisions must follow upon the technical advances in atomic energy. The whole fabric of international relations has already been profoundly affected. The nature of warfare, and therefore the way in which wars are begun or are prevented, has been changed as perhaps never before in history. The political and social sciences, industry, agriculture, and medicine will all be influenced increasingly as time passes. The list of areas in which atomic energy leads to change—and therefore to decisions that must be made—could be extended almost without limit.

The lives and happiness of the American people are at stake in these decisions. *Continued on page 2*

The Teacher and the Atom

by Mabel Studebaker, President, National Education Association

• America's teachers today face a heavy assignment. No matter what subject they teach, or what grade, they cannot escape the mighty questions raised by the dust of Hiroshima. Those questions make clear the menacing gap that exists between man's control of his physical environment and his control of his emotional reactions and the social framework in which he lives. Education is the only instrument we have for closing that gap.

If we continue to make atomic bombs before we gain a thoroughgoing knowledge of human relations, then at least our heavy assignment is well defined. We must attack, and attack again, the vast wilderness of ignorance in the field of human relationships.

Science must have a heart as well as a head. Science must be understood for what it is—an instrument, and only that, which the mind of man has conceived for quarrying into the unknown. But it is not a deity. No civilization has ever endured in which science had no objectives but its own deification. No civilization has ever endured in which scientific progress was without a moral equivalent.

Tomorrow our youngsters may be expected—on the basis of what they are now learning—to continue to make triumphant advancements in science. America's teachers must see to it that youngsters make comparable progress in the art of human relations.

A Task for Administrators

by Willard E. Goslin, President, American Association of School Administrators

• The world recognizes atomic energy as a force—a force of such magnitude that because we hold it in our hands we stand at a fork in the road, one prong of which leads only to destruction, the other prong taking us over the threshold to better living for more people everywhere. What the peoples of the world do not fully recognize is that they have at their disposal an even greater force, a force strong enough to mold the direction of our destiny, the force of education. Education has enough power, if wisely and vigorously used, to lead us to the right choice and to the use of atomic energy for the welfare of mankind.

The superintendents of schools in America do not control education, but they do influence it more than any other group in American life. There never has been a time when we were more in need of clear thinking and courageous action which would keep education close enough to the growing edge of American life so it is steadily in a position to exercise the constructive influence demanded by our times. This clear thinking and courageous action must take place community by community, all over America.

We must have a generation who understand atomic energy and its implications for a free people. If we get such a generation, the schools of America will have to make a major contribution to their growth and development. This places a new load of responsibility on the leaders in American education. It gives them one of the great opportunities of our times. Are the leaders in American education equal to the task? Are we able to so work with teachers, citizens, students, and scientists that we will emerge as a people with enough social intelligence to control and direct atomic energy for the benefit of all people everywhere? If we prove to believe deeply enough in education and have enough respect for the decisions of the common man when he is adequately informed, we will succeed.

Time will tell if we have been equal to the task.

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EDUCATION'S RESPONSIBILITIES

Continued from page 1

Will the people be in on these decisions? If the answer to this question is "No"—if these decisions are to be made by small numbers of "experts" because of a lack of knowledge and basic understanding on the part of the people as a whole—then we will have lost the essentials of democracy, and our basic liberties will be in very great danger.

This task of education is a grave responsibility, and a very considerable undertaking. It cannot be done overnight. But I believe that it *can* be done if there are applied to it the skills that your profession has developed and can be expected to adapt to this need.

You who are teachers and educators must assume a role of leadership in this matter, and I do not mean only teachers in the natural sciences. This problem touches and concerns all the social sciences, English, the humanities in general, and indeed the whole range and scope of teaching. The consequences of atomic energy are as broad as the spectrum of human activities, and therefore as broad as teaching itself.

"BABY PLAY WITH NICE BALL?"

—from Canada Wide Feature Service, Ltd.

Today there is a need—a desperate need—for the raw materials of atomic energy education. This need can be met. The basic information is neither secret nor difficult to secure. The men and women capable of using this information to prepare teaching tools must step forward from the body of American educators. The lag before complete materials are ready and widely distributed need not be a total loss. Indeed, you, more than any others, can see to it that this interim period is a fruitful one.

It is well to remember that this democracy of ours is founded upon a faith in the judgment of the people themselves. It is founded upon a belief that when the people are informed—honestly and clearly informed—their conscience and their common sense can be relied upon to carry us safely through any crisis. This is not only a faith, it is the way American society has lived throughout our 172 years of history. No segment of the population has greater responsibility than you who are teachers and educators to insure that we shall continue to live by these democratic principles in the atomic age.

IS MY SCHOOL MEETING THE CHALLENGE?

(Check List for Administrators)

1. Has atomic energy education been officially recognized (by the Board of Education and the Administration) as an integral part of our school program?
2. Have systematic efforts been made to help principals, supervisors, and teachers become aware of the meaning of atomic energy developments?
3. Are teachers presenting atomic energy information in basic courses, especially in science, social studies, and English?
4. Is there an all-school program of general information about atomic energy—carried on through such school activities as assemblies, clubs, film forums, corridor exhibits, student publications, etc.?
5. Do the all-school and classroom atomic energy programs complement each other?
6. Has such a program in the schools been projected into the community to increase the public's knowledge of atomic energy?
7. Is there a systematic program of evaluation (testing attitudes and general knowledge) as a basis for determining the effectiveness of instruction about atomic energy?

ABOUT THIS SUPPLEMENT

Atomic Energy Here to Stay is a supplement to SCHOOL LIFE. The March 1949 issue contains additional information on atomic energy education.

You may subscribe to SCHOOL LIFE by sending one dollar to the Superintendent of Documents, Washington 25, D. C. Additional copies of this supplement also may be obtained from the Superintendent of Documents for 10 cents each.

MEASURING THE RESULTS

Efforts to evaluate the atomic energy education program must include measures of the total program as well as of specific school events (assemblies, etc.) and of classroom instruction. An information and attitude test administered to the entire school at the beginning and end of the year might be one desirable means to employ. Observer panels, including both students and faculty, can be assigned to collect evidence and draw conclusions as to the effectiveness of particular all-school activities, such as corridor displays or assemblies. Student-faculty committees can conduct surveys of student reaction to specific events in the program. Classroom instruction, in this as in other critical areas, should be evaluated in terms of attitude changes and development of skills and understandings, as well as factual learning.

NEW INFORMATION AVAILABLE

As this supplement goes to press, the U. S. Atomic Energy Commission has released to Congress its Fifth Semiannual Report (available from Superintendent of Documents, Washington 25, D. C., for 45 cents each). It describes the dimensions of the national atomic energy program, and developments in organization research and production. The Commission states that the report is part of a program for public release of information which can be issued without harm to national defense and security.

ON THE COVER

The patient holds a glass containing a radioisotopic substance in solution. Hospitals and laboratories increasingly are using radioisotopes to confirm diagnoses made by traditional methods and to diagnose conditions with an accuracy in some cases not previously attainable. The U. S. Atomic Energy Commission makes constant shipments of radioisotopes to approved institutions here and abroad for a nominal fee.

Photograph by International News Photos.

The ancients knew few of the 96 elements that are known today. Carbon, copper, gold, iron, lead, mercury, and a few others were known before the time of Christ. Just about half of the 96 were discovered during the nineteenth century. In 1869, when Mendelyeev arranged the elements in the periodic table, 75 elements were known.

The Ladder of Atomic Science

> ***". . . The rapid Progress true Science now makes, occasions my regretting sometimes that I was born so soon. It is impossible to imagine the Height to which may be carried, in a thousand years, the Power of Man over Matter . . . O that moral Science were in as fair a way of Improvement . . ."***
>
> Benjamin Franklin, in a letter to Joseph Priestley, 1780.

RUNG by rung, century after century, men have striven to reach higher levels of understanding about the nature of the physical world. From the time of the ancient Greeks, the efforts have been as imaginative as they have been persistent.

In any listing of developments in atomic science, it is impossible to name all persons who have contributed to our greater knowledge. Some, like Democritus, the Greek (4th century B. C.), helped to lay a foundation. Others carried out experiments demonstrating that certain ideas were incorrect.

We must never forget that seemingly unrelated or isolated research findings, made by one or three or five anonymous scientists, may be stored for future use. Einstein's famous formula, E equals mc^2 lay in a stockpile for years before it was experimentally verified.

A listing of the developments in atomic science reveals two rather striking facts: (1) *Discoveries in atomic science have been made by men and women of many nations,* (2) *scientific advances, based one upon another, have come with increasing speed* especially during the past half century.

Some of the major developments are:

1808—Dalton (England) first used the term "atom," meaning "indivisible, that which cannot be cut in two." He stated that each element consisted of irreducible and infinitesimal particles.

1869—Mendelyeev (Russia) arranged the 75 elements then known in a (periodic) table based on their characteristics. By the use of this table, the existence of certain unknown elements could be predicted and later confirmed by experiments.

1895—Roentgen (Germany) discovered radiations which he called X-rays.

1896—Becquerel (France) found that pitchblende (a mineral containing uranium) gave off rays. This property is known as radioactivity.

1897—Thomson (England) identified the electron (the negatively charged particle that moves around the atom's nucleus).

1898—Marie and Pierre Curie (France) announced that they had isolated the element radium from pitchblende.

1905—Einstein (Germany) showed on theoretical grounds that energy and matter (mass) are equivalent; that is, they are different forms of the same thing. This suggested that atoms might be unlocked to produce unbelievably large amounts of energy, and that energy might be used to produce different, perhaps new atoms.

THE GIRL HANDLES RADIOISOTOPES WITH CARE
—*by courtesy of INP*

1911—Rutherford (England) visualized the atom not as a solid piece of matter but as a tiny solar system. In 1912, Bohr (Denmark) added his imaginative picture of the atom. The combined Rutherford-Bohr atom set the stage for the changing of one element into another by bombardment.

1919—Rutherford (England) discovered the proton (the heavy and positively charged particle in the nucleus of the atom). In 1919 he also bombarded nitrogen with helium nuclei (alpha particles) and obtained oxygen. *This was the first transmutation of one element into another.*

1931—Lawrence (United States) developed the cyclotron, a machine for speeding up protons to the high velocity necessary for the effective bombardment of atoms.

1932—Cockcroft and Walton (England) verified Einstein's theory that mass and energy were equivalent. They bombarded lithium with high-energy protons (hydrogen nuclei) and produced helium and energy.

1932—Chadwick (England) verified the existence of an uncharged subatomic particle (now called the neutron).

1932—Urey, Brickwedde, and Murphy (United States) discovered a heavy form of hydrogen (an isotope of hydrogen, now called deuterium).

1934—Curie and Joliot (France) reported that certain light elements (e. g. magnesium) could be made radioactive by bombarding them with high velocity helium nuclei (alpha particles). This report stimulated Fermi (Italy) to use neutrons in bombarding uranium. By this method he created a new element from uranium.

1936—Anderson and Neddemeyer (United States) discovered the mesotron (shortened to meson).

1938—Bethe (United States) advanced an explanation for the energy-producing power of the sun and other stars.

1939—Hahn and Strassman (Germany) announced that after bombarding uranium with slow neutrons, they found barium present. On the basis of their findings, Frisch and Meitner (German exiles in Denmark) theorized that by splitting the nuclei of atoms enormous amounts of energy could be released. This process is called fission.

1940—McMillan (United States) identified elements 93 and 94, neptunium and plutonium. Seaborg (United States) shortly afterward identified elements 95 and 96, americum and curium.

1942—Fermi, Zinn, and Anderson (United States) operated the first controlled, self-sustaining nuclear chain reaction (atomic pile), under Stagg Field Stadium, University of Chicago.

1944—Veksler (U. S. S. R.) proposed the idea of the synchroton, a modified type of particle accelerator from the cyclotron.

1948—Gardner (United States) and Lattes (Brazil) working with the cyclotron at the University of California, produced mesons artificially. This development provided a means to study subnuclear forces.

And what of the future? We can only say that *there is no reason to believe that we are near the top rung of the ladder.*

New Facts—New Choices

Having arrived where we have, having so vastly expanded our knowledge of physical matters, is a great accomplishment. But now we must live with the new facts.

The Chairman of the United States Atomic Energy Commission set forth some of the choices—how we mesh the facts into our existing social order—that face us. The statements below are excerpts from Mr. Lilienthal's address in Crawfordsville, Ind., September 22, 1947.

. . . Atomic energy and scientific discoveries have not and need not change the fundamental principles of democracy, which rest upon faith in the ultimate wisdom of the people, when they have been truthfully and clearly informed of the essential facts. This principle and this faith form the basis of the law establishing the civilian Atomic Energy Commission. If the people of this country want that principle and that policy to be made effective—the policy that it is *they* who decide their future and their fate—that is the policy that will prevail. . . .

No one . . . underestimates the importance of atomic energy as a weapon, as a weapon that has shaken previous military and diplomatic concepts to their foundations . . .

. . . But what we have here actually is not simply a weapon. Here is newly acquired knowledge of great and universal forces comparable to the forces of gravity and the forces of electric charges and of magnetism. . . .

The forces . . . within the atom are not new. Far from it. Without the atomic energy released by the sun, this country would be a lifeless crater.

What *is* new is this: that in our day, our generation, knowledge has so increased, that we are now actually on the long road to understanding atomic energy and making it serve men's needs.

These atomic forces are still not well understood by even the most learned scientists. But here are two towering facts of greatest importance to every living human being the world over:

First: Mankind has probably learned more in the past thirty years about atomic forces than in all the preceding centuries.

Second: Within the next few years—a decade perhaps—we should be in a position to unlock new knowledge about life and matter so great that wholly new concepts of human life will follow in the wake of this new knowledge. . . .

Such new knowledge inevitably brings changes. . . . Some of these changes are in process at this moment. Thus the atomic weapon has changed the relations between nations. . . .

. . . No one can predict just what changes will come of knowledge that goes to the root of all things physical. . . . What is important to understand is not just what the precise effect of knowledge of these basic forces will be—which is necessarily speculative—but rather that important changes will come—which is as certain as anything in this world can be. . . .

What we should be concerned about, and what we should make sure of is that the changes shall be fitted into the American way of doing things, that those changes shall not be so imposed upon us that individual freedom is impaired. We must make sure that the American people will have a say-so, and a decisive say-so, in the adjustments these discoveries will bring in community life, in our agricultural, educational, industrial and military institutions. You must make dead sure that your public servants in all branches of your Government, civil and military, legislative and executive, all understand clearly that atomic energy *is* your business. . . .

It comes down to this, the whole problem of atomic energy, and of all the great scientific discoveries it is bound to bring—it comes down to this:

First: We must persist until we find ways whereby mankind will not make use of these discoveries for destructive and evil ends;

Second (and closely related to the first): We must find ways of encouraging and stimulating the application of these discoveries and new ones to come, to things that are beneficial and helpful to mankind and to the best of human aspirations. . . .

Nothing could weaken the security of our country in the atomic field more quickly, nor more surely slow up research in cancer control, say, than to permit science and scientists to be kicked around by the organized forces of ignorance and demagoguery, and petty politics. You don't have to have scientific training to sense that this would be bad, bad for you . . . bad for the country. This sort of thing is a real danger to our scientific progress. . . .

There are many other broad issues where your judgment will be essential, and your interest vital. These might include such matters as:

- **the proposals for international control of atomic weapons
- **the conditions under which the present Government monopoly in this field can safely be changed to private competitive production
- **the share of the national budget that should be devoted to scientific research
- **the adequacy of protection against health hazards from radioactive materials in the air and on the ground
- **the proper relation of civilian direction to the military, in this field.
- **what kind and size of navy, army, and air force we need in the light of developments in scientific warfare
- **what sense the proposals make that we go underground.
- **the workability of decentralization of cities as a defense measure
- **how rapidly atomic fuel may supplement coal, oil, and water power as a source of electricity
- **the wisdom and workability of censorship of the press and radio as a means of maintaining secrecy in this field, under peacetime conditions

Such a list of policy issues could be extended almost indefinitely. . . .

It is important that the facts and analysis of policies should come to you from a variety of sources, not from only one, and above all that they should *not* come solely from official sources. This variety gives you a chance to check one version against another, and draw your own conclusions. . . .

The Atomic Energy Program of the People of the United States

"The United States has today under a rather considerable head of steam what is, as a whole enterprise, the largest, most complex and most extensive scientific, educational, industrial, technical and weaponeering undertaking . . . in the history of the world."

—David E. Lilienthal (interview with Archibald MacLeish), *Life*, September 27, 1948.

by Morse Salisbury, Director, Public and Technical Information Service, United States Atomic Energy Commission

THE PEOPLE of the United States, in their national atomic energy development program, own and operate a large industrial and scientific enterprise. The total operation, carried on for the people by a Commission established by the Atomic Energy Act of 1946, is large from any physical viewpoint.

This enterprise of the people of the United States begins with the mining of uranium ores in the Belgian Congo and Canada and on the Colorado Plateau in the United States. Uranium is the raw material of the enterprise, and it has become one of the most precious materials in the world. The Atomic Energy Commission is offering stable prices and bonuses for new discoveries in order to expand uranium production in the United States. Intensive prospecting is likewise going on in many other parts of the globe. The American program at present depends heavily upon the ores mined in the Belgian Congo and Canada.

After mining, the next step in the process of making, out of uranium, fissionable materials—the basis of the atomic energy industry—involves many complex processes carried on at scores of plants in the United States under contract with the Commission. At the end of this chain of operations the uranium comes out either in the form of a gas, uranium hexafluoride, to be used at the plant at Oak Ridge, Tenn., or in the form of highly pure natural uranium metal to be put into the great reactors at Hanford, Wash.

The plant at Oak Ridge—probably the largest industrial plant under one roof—is in the shape of a large **U** about a half mile long on each upright and almost that long on the bottom crosspiece. It is six stories high and wider than a football field is long. In its maze of pipes and pumps, an automatic process based on the tiny difference in weight between the fissionable part of uranium (U-235) separates this form of uranium from the much more abundant U-238.

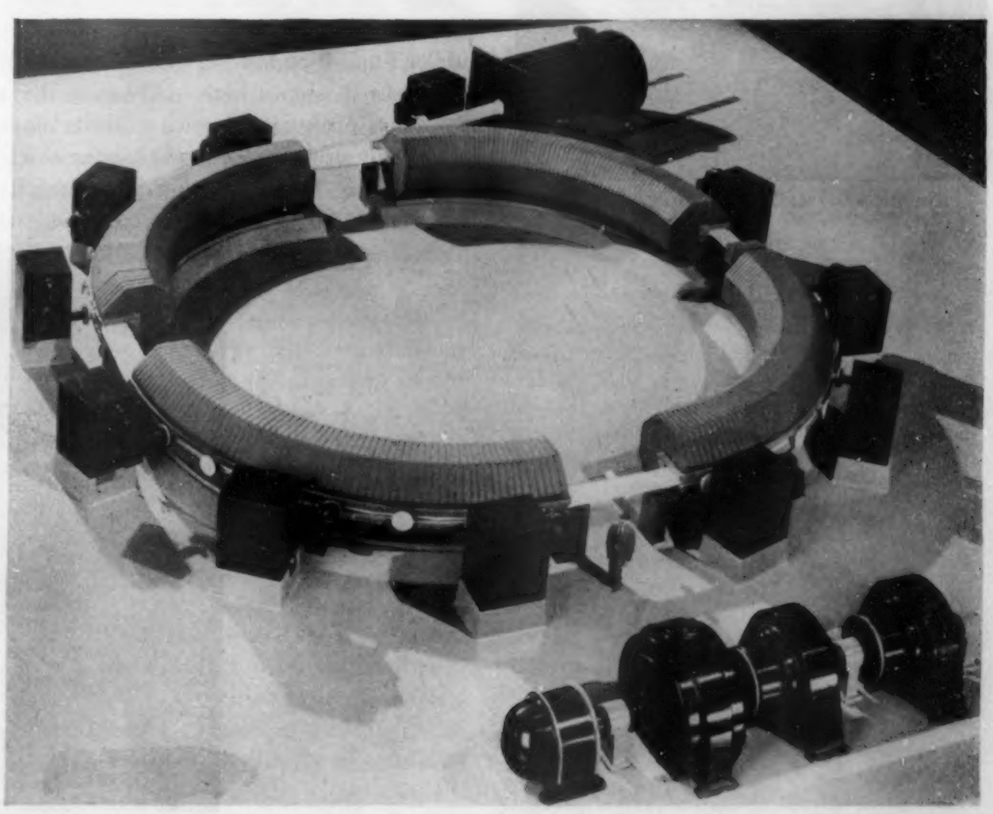
The second plant for making fissionable material—at Hanford in the State of Washington—is even more unusual and more costly than the Oak Ridge installation. Here, pure uranium metal is processed through giant reactors—the fundamental machines of the atomic age. In the process, the alchemy of neutron bombardment from the U-235 in the metal makes a new element, plutonium, out of the U-238. This new element, like U-235, is fissionable.

From Oak Ridge and Hanford, the U-235 and plutonium may go either to the weapons laboratory of the national atomic energy program or into various research and developmental projects for the advance of peacetime uses of atomic energy.

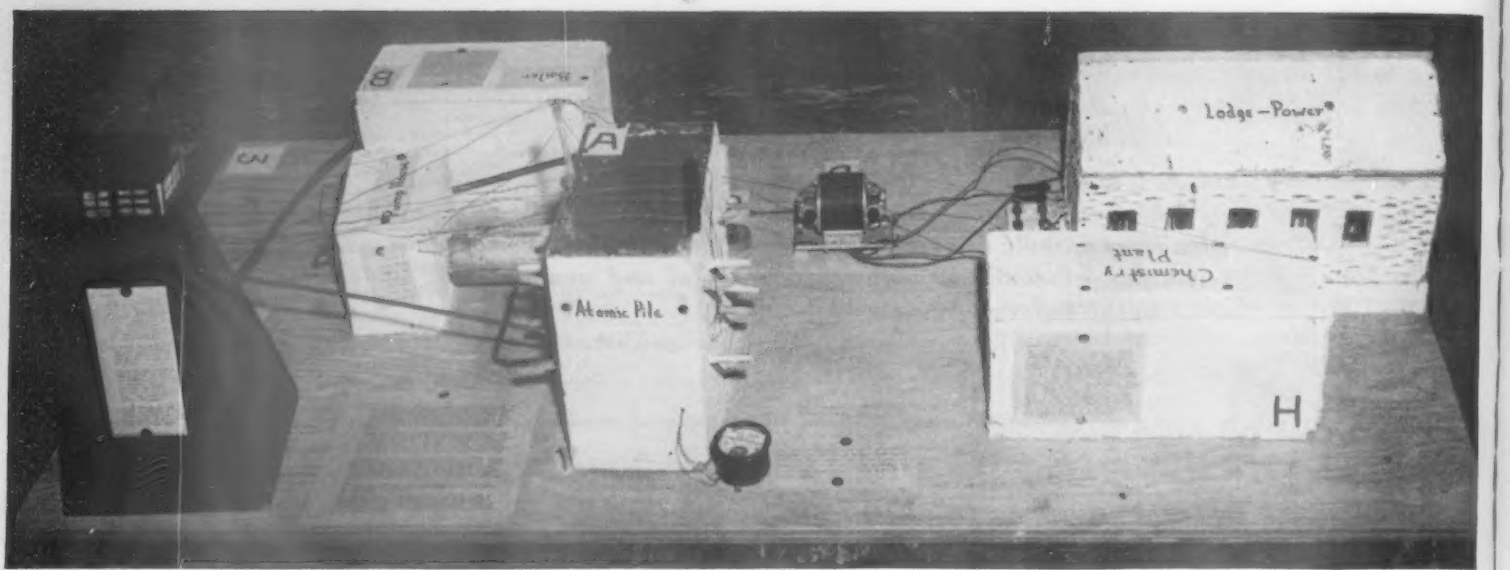
That which goes to the Los Alamos laboratory is handled in another great center of the atomic energy program—the weapons fabrication and research establishment. This is operated under contract by the University of California. As new weapon designs are developed, they must be tested and the Commission maintains a proving ground for weapons 5,000 miles from the western coast of the United States at Eniwetok, an atoll in the Marshall Islands of the Pacific.

Besides this chain of production of fissionable materials and the use of part of

Continued on page 13



MODEL OF ACCELERATOR OF TYPE USED FOR BASIC RESEARCH. NOTE RELATIVE SIZE OF MAN IN FOREGROUND



IN 1 WEEK'S TIME MOUNT BAKER (DEMING, WASH.) HIGH SCHOOL STUDENTS BUILT MODEL SHOWING THEIR IDEA OF PLUTONIUM PRODUCTION PLANT

RADIATION AFFECT RATE OF GENE MUTATION

Make and Show

ATOMIC energy is a "natural" for exhibit work. In fact, many of the relations, processes, and developments can be understood by students only through exhibits.

Science students at the Mount Baker High School, Deming, Wash., under the guidance of Teacher Dorothy Massie, produced a number of exhibits, two of which are shown here. Another example, at the White Plains (N. Y.) High School is shown on page 8.

Many exhibits about atomic energy were on display at New York City's Golden Jubilee Exposition last year, one example of which also is shown here. Although they look more professional, such exhibits may be as easily prepared by students; the chief difference is in the amount of research rather than in the techniques of presentation required.

Because atomic energy is so much in the realm of theory, some aspects can be demonstrated best by charts, an example of which is shown here. Structures of atoms and the operation of the Geiger counter have been pictured in this way.

A few professional exhibits have been prepared and used in schools but for the most part they are either expensive or difficult to obtain. For this reason and because new facts are constantly being announced, teachers must rely largely on their own resources in developing exhibits. Some of the references listed in this issue provide examples and suggestions from which exhibits can be developed.

CARBON ISOTOPE, C-14, IS USED TO STUDY LIVING PLANT PROCESSES

STUDENT WORKS ON MODEL HE HELPED BUILD TO SHOW CHAIN REACTION PROCESS

Where the School Takes Hold

By Dorothy McClure and Philip G. Johnson, Office of Education [1]

"(Man) will have to effect a radical transformation in his approach to and philosophy of education . . . One of the liabilities of modern education is that it has contributed to a dangerous compartmentalization both of knowledge and of progress . . . the Whole Man requires whole education . . ."

NORMAN COUSINS, MODERN MAN IS OBSOLETE, *Saturday Review of Literature*, August 18, 1945

AMERICAN students are making atomic energy their business in high schools all over the country—from White Plains, N. Y., to Kelso, Wash. They are studying it in science and social-studies classes, through assembly programs and hall exhibits, by reading the school newspaper and examining the art class's mural. Electron, proton, neutron, chain reaction, and radioisotope are becoming part of the common vocabulary of high-school students. Teachers and students are learning together in many cases. "It gets to be a matter of self-respect to understand what the students are talking about when they begin on atomic energy," said one instructor.

What things are important to know about atomic energy? How can boys and girls learn about it efficiently? These are questions in the minds of many teachers. The preceding articles help to answer the first; this article the second.

The Incidental Approach

New scientific and social developments ordinarily get into the school curriculum by a casual process. This is usually the course of least resistance and, at best, is slow and unsystematic. It has been responsible for the educational lag so often noted—that is, the gaps which exist between the needs of society and the program offered by the school.

Through this process the basic principles of atomic energy and their implications for society will be treated in American classrooms—eventually. The basic concepts related to the use of atomic energy might shake down to appropriate places in the school program, tending to pervade the entire curriculum as society moves further into the atomic age. But do we have the time? Perhaps a half century would be required for this casual approach to achieve an adequate atomic energy education. It is doubtful that the resulting compartmentalized instruction would be effective.

The Subject-Unit Approach

Comprehensive units on atomic energy offer more promising results. They can be introduced at once, within the existing educational framework. They can be so planned as to help students understand both scientific and social aspects of atomic energy developments. Such units should provide for consideration of basic scientific facts; they should discuss the problems of domestic and international control; and they should make clear both the destructive capacity and the hopeful potential of atomic energy.

Effective teaching by the subject unit approach will require cooperation among the faculty. Whoever takes responsibility for this job should recognize the unusual breadth of this particular subject matter. Science teachers must not ignore social and political problems; neither can social studies teachers feel that their students have gained understanding of atomic energy issues without learning basic scientific facts. Thus the Herkimer (N. Y.) High School social-studies class considered many of the same topics as did the Erie (Pa.) High School chemistry class in its study of atomic energy. Incidentally, pioneer work in developing units on atomic energy has been done by English teachers, as in the programs at Oak Ridge, Tenn., and the Simon Gratz High School, Philadelphia.

Wherever the comprehensive unit is studied, it should have a minimum of 3 weeks' time. It should not stand as the only treatment of atomic energy. The study of a limited phase of atomic energy in some courses should supplement the comprehensive unit; in others the study should provide for planned repetition of atomic energy concepts. Specific phases of the subject can properly be studied in several courses where comprehensive units might seem inappropriate—English, industrial arts, and health, for example. If each such limited treatment is part of an integrated plan, the total effect of the comprehensive units plus all of the specific references will go far in helping students understand atomic energy problems.

Some suggestions for the placement of atomic energy information—both in comprehensive units and through limited treatments—in the secondary school follow.

Atomic Energy Information in the Science Program

Comprehensive units may be taught in general science, biology, chemistry, or physics. They can be built around such questions as:

General Science.—What is atomic energy? What can atomic energy do for me? What are the raw materials for atomic energy? How can the release of atomic energy be controlled? How can atomic energy aid man in solving problems of health?

Biology.—How is the use of atomic energy related to living things? How do high energy radiations affect health and heredity? How can radioactive materials aid in studying life processes and in the diagnosis and treatment of illnesses? How do discoveries about atomic energy affect man's behavior? What is the relation between solar and atomic energy?

Chemistry.—What is the chemistry of atomic energy? What is the structure of atoms? How were additional elements discovered? What parts of atoms are involved in ordinary chemical changes? What are nuclear changes and how do scientists account for the high energy of nuclear reactions? What are isotopes? How are they produced and used?

Physics.—What have physicists contributed to atomic energy developments? How does atomic structure help to explain properties of matter? How can high energy radiations be produced? How can high energy radiations be used in product development and testing? How can physical properties be used in separating isotopes?

Specific topics concerned with atomic energy development may be included in the following courses which are often a part of the science program:

Elementary School Science.—Units on fire, fuels, machines, electricity, magnetism, plant growth, animal and human health, water, minerals, the sun and stars, and biographies of scientists.

General Science.—Units on energy, power, transportation, health, astronomy, conservation, food, heating and lighting, rocks and soils, plants and

[1] Specialists for social sciences and science respectively.

animals, human behavior, control of diseases, and scientists.

Biology.—Units on the microscope, nutrition, reproduction and heredity, biological controls, adaptations of living things, conservation practices, physiology of living things, and biologists.

Physics.—Units on the nature of matter, potential and kinetic energy, mechanics, heat, light, magnetism, electricity, radiations, and physicists.

Chemistry.—Units on the nature and structure of matter, methods of purifying substances, chemical changes, metals and metallurgy, carbon chemistry, drugs and medicinals, and chemists.

Related Science Courses.—Units on processing of materials, analyses and testing of materials, use of materials, inventions, occupational guidance, and occupational hazards.

Advanced Science Courses.—Topics such as electronics, nucleonics, industrial processes, product testing, health services, research, laboratory technics, occupations, photography, earth science, consumer education, and applied science.

(Among the learning experiences suggested at the end of this article, the following are especially applicable in science classes: Nos. 1–9, 11–23, 25–27, 29–30.)

Atomic Energy Information in the Social Studies Program

Comprehensive units on atomic energy development, emphasizing the social, economic, and political implications, may be organized for social studies courses around such questions as:

Social Problems or Civics, Senior High School.—How can we control and use atomic energy for the best welfare of all? What scientific principles must be taken into account in any control scheme? What is the present status of domestic control and plans for development? What plans for international control have been offered? What are the implications of atomic weapons for international relations, and specifically for American foreign policy? What are the potential applications of atomic energy in industry, conservation, medicine, power production, agriculture, etc.? What can our class do to help meet the problems connected with atomic energy today?

American History, Senior High School.—How does the "atomic revolution" affect American foreign policy? Using this unit as either an introductory or a summarizing unit in the year's work, American history classes would need to consider the same questions suggested immediately above, with emphasis on international control and atomic warfare. In addition, the machinery through which our foreign policy is made, policies followed since World War I, current relations with other major powers, and the part of the United States in the development of the UN, may be examined in relation to atomic energy developments. Why did this development center in the United States?

World History, Senior High School.—How is the "atomic revolution" affecting world history? In the Superior, Wis., High School, the unit is called, "Atomic Power and its Effects on Peace." Under either title a unit on atomic energy will be a stimulating beginning or ending for the year's work. Emphasis will be on the total world scene, as distinguished from that of the Nation. Many of the same questions suggested for the social problems course, however, would apply.

Limited phases of atomic energy development may be treated in the following topics which are now commonly a part of the social studies program:

United States History, Junior or Senior High School.—*Cultural advances, or standard of living*—consider medical uses of atomic energy, potential benefits in heating houses, applications in transportation; *conservation of natural resources*—consider potential substitution of atomic energy for coal and oil; *industrial progress*—consider potential uses of atomic energy and radioactive byproducts in factories, transportation, etc., new industries and jobs which may be created; *agricultural developments*—consider uses of isotopes in agricultural research, effects on farm life of potential applications of atomic energy in fields of power, medicine, etc.

WHITE PLAINS (N. Y.) STUDENTS PLAN MURAL

World History, Junior or Senior High School.—*Ancient world*—Greek speculations on nature of matter (Democritus); *industrial revolution*—include atomic energy applications; *growth of scientific knowledge*—include story of research in atomic energy, biographies of atomic scientists, research applications of radioactivity; *World War II*—first atomic bomb, comparisons with other types of warfare; *postwar problems*—meaning of atomic warfare in world relations and in United States foreign relations; *natural resources*—in studying distribution pattern and uses of each in modern industry and warfare, pitchblende and carnotite should be included; in comparing resources of major powers include atomic energy raw materials.

Community Civics, Junior High School.—Study of public opinion might be centered on current views about atomic energy—surveys may be made in community to ascertain popular level of knowledge and opinion on various atomic energy problems.

Geography, Intermediate Grades, Junior and Senior High School.—*World resources*—industrial potential of various regions—consider meaning of atomic energy resources and of potential application of power, etc., derived from them; *agricultural production and potential of various regions*—consider meaning of agricultural research through use of isotopes.

(Among the learning experiences suggested at the end of this article, the following are especially applicable in social studies classes: No. 1–7, 9–19, 21–30.)

Atomic Energy Information in Other Courses

While it may not be desirable to introduce a comprehensive unit in other school courses, there are many "pegs" which can be used—without violating the objectives of the course—to broaden student understanding of atomic energy.

English.—Problems arising from atomic energy development provide excellent topics for round tables, research papers, and oral reports. The small, but growing collection of popular books on atomic energy and atomic scientists can be included on reading lists. For example, the Quincy, Mass., High School, and many others now include John Hersey's *Hiroshima* in the English reading program. Units such as those on "Magazines in American Life," "Propaganda Analysis and Public Opinion," "Biographies," "Essays," can include materials on atomic energy. (Among the learning experiences suggested at the end of this article, the following are especially applicable for English classes: Nos. 1–2, 4–5, 7, 9, 11–18, 21–25, 27–30.)

Mathematics.—Teachers of mathematics can draw on atomic energy materials for study of exponents, geometric progressions, conversion units, symbols, formulas, equations, space models, and problem solving.

Art.—Students of art may find many striking subjects rising from the problems of atomic energy development. Art classes can arrange displays, murals, and bulletin boards on atomic energy for classrooms, school corridors, and special exhibits in the school or community.

Industrial Arts.—Industrial arts classes can study the potential influence of atomic energy developments on job opportunities and of their effects on metallurgy and electronics. Pupils can make models of atomic piles, arrange devices to demonstrate chain reaction, and prepare other exhibits to aid the student body in understanding atomic energy.

Health.—Classes in health can study the use of radioactive substances in medical research and treatment, the effects of radioactive materials on the human body, and the measures which have been developed for protection against overexposure to them.

The Interdepartmental Unit Approach

This approach to atomic energy education is perhaps the ideal one in terms of "learning by wholes" and for avoiding com-

partmentalized thinking. Teachers of science, social studies, English, art, and other subjects can more nearly assure availability of needed resources if they work as a group rather than individuals. Whether employed in cooperative units, in a temporarily designed core situation, or in a core course, the interdepartmental approach probably provides the most effective opportunities for use of audio-visual materials, student participation techniques, democratic planning, and action projects. A teacher might attempt the whole job within the confines of a single course, but the magnitude of the task suggests that it is more likely that the job will be well done if it is undertaken on an interdepartmental level.

The School Activities Approach

The school activities approach calls for a flexible, coordinated plan. It involves using assembly programs, corridor displays, homeroom discussions, club periods, and other activities to develop understanding of atomic energy problems. It does not compete with classroom study; effective utilization of this approach requires that its efforts be integrated with those carried on in classrooms.

Such a plan may grow out of student council activities, the work of a social studies or science class, the faculty orientation program, or a special committee appointed by the school administrator. No matter where it originates, it seems desirable that students and teachers cooperate in the planning. The wider the participation, the wider the interest.

The planning committee might begin by surveying all-school activities and facilities to see which ones are suitable for use in the atomic energy program, and by finding out from the principal what funds and other school facilities can be made available.

As potential channels for reaching the student body are spotted, committee members can examine each one as follows:

Assemblies.—Can assembly programs on various phases of atomic energy be arranged? If necessary, can extra assembly time be scheduled? (This may be essential; if regularly planned features are sacrificed for atomic energy, students may have negative reactions.) Can effective speakers be located for some of these programs? Can films be shown at one or two of the assemblies? Can the dramatics class (or club) present a skit? Can panel discussions or demonstrations developed in science, social studies, or English classes be used for programs?

School Publications.—Can a reporter be assigned to cover the atomic energy programs in assemblies, clubs, class work, and hall displays? The White Plains, N. Y., High School did this. Will the student editors be willing to print occasional editorials on atomic energy problems? Will the editors publish reviews of available books and articles? Will the editors publish essays, poems, or stories dealing with atomic energy?

Corridor Displays.—What can various departments contribute from class projects to displays for the corridors? (In Tulare, Calif., the science classes prepared charts and models for such exhibits. In Herkimer, N. Y., the social studies class kept a hall bulletin board up to date with posters and clippings. In White Plains, N. Y., the journalism class maintained a corridor display of news items, ending the project with an analysis of the items.) What exhibit and bulletin board space is available? How can exhibits be placed to attract the most attention from passers-by? What special lighting would be useful? Can exhibits coincide with events that bring adults into the school buildings—e. g., PTA meetings or school plays? What out-of-school sources of exhibit materials should be investigated?

Library.—Can a special reference shelf be provided for atomic energy materials (books, pamphlets, and magazines)? Is space available for posters, book jacket displays, and other exhibits? Can student book reviews be made available on bulletin boards or in booklet form?

Clubs.—Can the science club prepare displays for the school corridors and for other clubs? The Lower Merion (Pa.) H. S. physics club made a mouse trap device to illustrate chain reaction. Can the science club furnish school and community groups with speakers on atomic energy? Can the photography club assist by preparing photographs, enlargements, and slides? Can the audio-visual service club present films, slides, and recordings? What contributions can clubs such as the following make: Four–H; Current Events; Dramatics; Art; and Handicraft.

The earlier the planning committee can schedule its events, the better. The entire program must be planned as a developing one, with each event building on the previous assemblies, displays, and so on. The committee should guard against the attitude that any one effort can do the job.

Orientation for School Staff

Many well-informed adults realize their lack of information about atomic energy developments. Teachers are no exception.

School staff members can work together to gain the understanding they need to plan a program of atomic energy education. Different teachers can serve as discussion leaders at staff meetings or present information to the rest of the faculty. In Kalamazoo, Mich., for example, three faculty meetings were devoted to atomic energy. In the White Plains, N. Y., High School, a science instructor presented two lectures on the scientific principles of atomic energy. A third session, led by a social studies teacher, was devoted to the social implications of atomic energy developments. Following these discussions, materials for individual reading were distributed to all members of the staff. Somewhat later, but still early in the school year, staff members previewed audio-visual materials on atomic energy, thus broadening their own understanding and at the same time selecting materials for student use.

Another plan is to invite guest speakers and discussion leaders who are qualified to talk about various phases of atomic energy developments. Such a series of meetings is currently being held in New York City for science and social studies teachers. Colleges and universities can usually furnish speakers. Such speakers must, however, be sensitive to the scientific limitations of their audience.

Still another plan is for a teacher delegate or delegates to attend an "atomic energy workshop" or institute, several of which are scheduled by universities, State departments of education, or other educational agencies in various parts of the country. The University of Nebraska, for

Continued on page 13

CARTOON PICTURE BOOK TELLS STORY OF ATOMIC ENERGY DEVELOPMENT IN UNDERSTANDABLE WAY

Learning Experiences in Atomic Energy Education

WHATEVER the approach to be used, maximum value can be gained by using vital and varied learning experiences. Some of the suggestions that follow have been tried in pioneer programs of atomic energy education. Others have been adapted from learning experiences which have proven effective in studying other social issues.

1. Read the current issue of two monthly magazines and newspapers and news magazines for one week to locate every item concerning atomic energy. Prepare a vocabulary of terms needed for understanding these items. List new facts learned from the articles. Present these, with explanations, to the rest of the class.

2. Select six terms which you consider basic for understanding atomic energy problems. Prepare "picture definitions" of them, in the manner of the picture dictionaries which are published for young children. Post these "picture definitions" on the bulletin board for others to study.

3. Prepare drawings (charts or diagrams) to illustrate a speech on the topic, "How Atomic Energy is Released," or to be used as a corridor display. Present the illustrated talk or the display to your class.

4. "Science Knows No Nationality." Prepare a bulletin board display to illustrate this statement, drawing on facts about atomic energy research. Find pictures and clippings or draw cartoons about the major steps which have been achieved, labeling each by the country where it occurred.

5. Study the Army Signal Corps film, *Tale of Two Cities*, to get information about the destructive effects of atomic warfare. Follow your study of the film by writing a paper to describe what would have been the effect on your town if the "Two Cities" had been the two largest ones in your State.

6. Make a map of the world, showing where deposits exist of the raw materials which yield atomic energy. If the map is done on a large scale, post it on the bulletin board. Explain to the class the significance of the facts presented.

7. Working with other members of your class, present a "radio broadcast" based on the script, "Atomic Energy Is Your Business." Obtain the script by writing to the Educational Radio Script and Transcription Exchange, Office of Education, Federal Security Agency, Washington 25, D. C. Arrange to present it at an all-school assembly, or for one of the adult groups of your community.

8. Prepare an exhibit to demonstrate the principle of chain reaction. One class, in Ardmore, Pa., used mousetraps for this purpose.

9. Appoint a class committee to keep a section of the bulletin board up-to-date with items concerning problems of atomic energy.

10. In current events discussions, give attention each week to developments in efforts at international control of atomic energy and to new information about peacetime applications.

11. Appoint one member of the class to check radio programs and announce to other students the time and station for any significant broadcast about atomic energy.

12. Appoint a committee to make a systematic check of magazines in the school library and to report to the class on useful articles about current developments in atomic energy.

13. Prepare an oral or written report on one of the following topics:

The Necessity of International Control of Atomic Armament.

Discussions of International Control of Atomic Energy in the UN Assembly.

Prospects for Using Atomic Power for Transportation.

Using Radioactive Isotopes to Increase Agricultural Production.

The Use of Radioactive Isotopes in Industrial Research.

The Use of Radioactive Isotopes in Medical Research.

The Work of the United Nations Atomic Energy Commission.

How Atomic Energy Workers Are Protected from Radioactive Elements.

The Story of the Manhattan Project.

Power from Atomic Energy.

Labor Relations in the Atomic Energy Industry.

Use at least two or, if possible, three sources of information. Check the *Reader's Guide* to find the most recent periodical articles available on your subject.

14. Plan and administer an "information survey" on atomic energy. Use 6 or 8 brief questions about basic facts of atomic energy. Plan your interviews to include persons of various ages, occupational groups, etc. As a first step, interview selected students to get an idea of how much information high school students have about atomic energy and to be certain your questions are clearly phrased. Submit your poll results to the local newspaper for publication.

15. Prepare brief biographies of "Men of Manhattan"—Fermi, Urey, Bohr, Oppenheimer, Compton, Lawrence, Wigner, etc. Present them to the class as a floor talk, or prepare a booklet for the library collection on atomic energy.

16. Prepare a list of words and phrases needed to understand atomic energy developments. Use them for a "definition spell down."

17. Prepare a test on basic facts about atomic energy and arrange with the English department to have it given to all students. Use multiple choice or true false items. Publish the results and the correct answers in the school newspaper, or post them on the bulletin board. (A class in Kelso, Wash., gave such a test.)

18. Follow the school-wide test with an assembly program designed to teach the student body important facts about atomic energy, including those they missed on the test.

19. Investigate museums, libraries, colleges, and universities near your school to discover how they could help your class in its study of atomic energy. Look especially for: Exhibits, pamphlets, and books not in your school library, speakers who might address your class or an all-school assembly. (White Plains, N. Y., had speakers from Columbia University and Brookhaven Laboratories; Mount Pleasant, Mich., had a speaker from the University of Michigan.)

20. Build models to illustrate basic information about atomic energy: Structure of atoms, pile reactors, radiation detection devices, protecting shields, remote control mechanisms, shipping containers.

21. Read *Must Destruction Be Our Destiny* (Harrison Brown) or *Modern Man is Obsolete* (Norman Cousins). Select sections to read to the class. Lead a discussion on the significance of the sections you have read.

22. Write an article for the school newspaper, discussing one of the potential peacetime uses of atomic energy.

23. Write an editorial on one issue connected with atomic energy development and submit it to the editor of your school paper, or of your local paper.

24. Prepare news articles for the local paper, reporting on work done by school classes on atomic energy, and high-lighting any exhibits students have on display in the school.

25. Arrange to present panel discussions on some of the topics suggested above for adult groups in the community or on the radio. Groups which might be interested in such programs include: PTA, League of Women Voters, Kiwanis, Rotary, Lions, church study groups, and veterans' organizations.

26. Prepare displays on atomic energy (posters, demonstration devices, cartoon collections, comic strip explanations of basic facts) and arrange to put them on exhibition in a public lobby, as: the public library, the movie theater, the city office building, the county office building, the railroad station, the post office. Or arrange with various merchants to place such displays in store windows.

27. Write and submit to your local radio station (or school radio system) announcements for use between programs; in each announcement present some fact which you think is important for the general public to know about atomic energy.

28. Arrange with the librarian of the public library to display a collection of readable books on atomic energy, and to have an annotated bibliography available for distribution in mimeographed form.

29. Arrange film forums, inviting the general public or presenting them for particular groups such as the PTA, League of Women Voters, etc. Select the films from the list on the inside back cover of this publication. Prepare members of your class to present the film, telling the audience some main points to look for; lead discussion after the film has been shown; perhaps give a brief test (prepared in advance by the class) to be used as a basis for discussion.

30. Arrange an "atomic energy institute" in your school; plan a program of films, speakers, panels, forums, and discussions. Invite civic groups in the community. (In Springfield, Mo., the senior high school sponsored a 3-day program of this kind.)

How the School Reaches Out

by George L. Glasheen, U. S. Atomic Energy Commission, and John Lund, Office of Education

"This is an atomic age, and the only way I can keep in tune with the times is to go back to school."

Louis Rich, retired businessman of South Orange, N. J., 85 years old. *Washington Daily News,* October 21, 1948.

STAMFORD, CONN., is one of many communities that has become atomic energy conscious. The adults of Burlington, Iowa, have also begun to learn about the atom. Many citizens of Portland, Oreg., are no longer stumped when their teen age children ask what an isotope is. The whole State of Nebraska is feeling the impact of atomic education: The State university and State organizations work closely with the schools. Supervisors from the State department of education take kits of atomic energy information with them when they visit the schools, and actively promote atomic education.

In many communities and States the schools have abandoned their traditional isolationism from the main stream of life. They have recognized that atomic education is a must—not just for the next generation—but, now, for the adult citizen. They have seen that our citizens seek a way to learn the simple facts of atomic energy and its social and economic implications. They have assumed a responsibility for helping meet this need.

The need for developing a community-wide action program on atomic energy education now challenges every school in America. Time is short. We cannot leave such education to a "next generation"—as we could leave the development of electricity, say, or the perfection of the airplane.

So here is your job. It will make demands upon your vision and your energy. Skills will have to be developed. The urgency of the task demands, however, that effort shall not wait upon the perfection of skills. Rather, these will come with the doing.

Fortunately, working with the community is not a one-way proposition. You generally get back more than you put forth. Even if you are not situated so as to be able to get frequent assistance from nearby colleges, there are probably science-minded persons in your area who will help teachers and students in working out programs. They may address teacher groups or student assemblies; they may obtain films for you, or help in any number of ways. This type of relationship reduces the load on teachers, vitalizes the school program, and strengthens the school-community bonds. Working with the community pays dividends.

Here, then, are a few programs of action—programs already used by school systems—for helping the people of the community to learn about atomic energy:

1. Organize an atomic energy planning council, community-wide, and representative of all groups within your town that have an interest in public education—Parent-Teacher Association; League of Women Voters; veterans' organizations; service clubs; churches and schools and libraries; labor groups; farm groups; and local merchants and industrial leaders.

2. Establish under the council a community committee on atomic information. It should not be difficult to obtain some donated library or office space and some volunteer assistance. Encourage the committee to become a working group—an integral and important factor in the educational life of your town.

3. Stimulate the council and its committees to *act* as a clearinghouse for literature and other materials and services on atomic energy. Develop a collection of helpful books. Obtain and keep in stock reprints and pamphlets for distribution. Arrange for films, filmstrips, and records. Furnish exhibits. Know *where* materials, speakers, and other services may be obtained.

4. Encourage libraries to assist in arranging recommended reading lists and to feature books and informational exhibits on atomic energy.

5. Enlist local radio stations and daily press to give greater coverage to popular presentation of atomic energy subjects.

6. Ask motion picture theaters to show atomic energy films as they become available.

7. Obtain speakers for meetings and discussions on atomic energy. Nearby colleges and universities, as well as local scientific and professional associations, are usually good sources for finding appropriate lecturers.

8. Sponsor quiz contests for adults, and provide prizes for winners, donated, perhaps, by local tradesmen.

STATE EDUCATION OFFICIAL IN NEBRASKA DISCUSSES ATOMIC ENERGY WITH STUDENT AND FACULTY

9. Conduct an "information" survey to determine your town's atomic literacy.

10. Mobilize community-wide participation through the organization of an "Atomic Energy Week."

For greatest service to the community, atomic education has to be a continuing project—not the facade for one big community event only. The schools can play a part—an important part—in building a community understanding of atomic energy. It will take time; it will take effort; but it will help to bring sorely needed understanding to the people of America, the people who make the decisions.

For Further Study

The list of references contains only a few of the available materials on atomic energy. You may find additional books and pamphlets by using the bibliographies included in this list.

Books and Pamphlets

BROWN, HARRISON. *Must Destruction Be Our Destiny?* New York, Simon & Schuster, Inc., 1946. 159 p. $2.

A readable discussion by a scientist, emphasizing what it will mean if efforts to provide for international control of the atomic bomb should fail. Useful in senior high school classes to establish the urgency of control problems.

BURNETT, R. WILL. *Atomic Energy—Double Edged Sword of Science.* Columbus, Ohio, Charles E. Merrill, Inc., 1949. 32 p. 40 cents (10 copies or more, 30 cents each).

Prepared for the Committee on Experimental Units, North Central Association of Colleges and Secondary Schools. Treats scientific facts and social implications of atomic energy. May be used as text material for a unit on atomic energy in either science or social studies classes. Written for high school students.

CAMPBELL, JOHN W. *The Atomic Story.* New York, Henry Holt & Co., Inc., 1947. 297 p. $3.

An account of atomic energy research, with a simple explanation of the basic principles of nuclear physics. Useful for special reports.

EVANS, HUBERT M.; CRARY, RYLAND W.; *and* HASS, C. GLENN. *Operation Atomic Vision.* National Association of Secondary School Principals, 1201 Sixteenth Street NW., Washington 6, D. C. 1948. 60 cents.

Basic text material for science, social studies, or other classes, stressing the community participation approach. Bibliographies and suggestions for activities.

FOX, WILLIAM T. R. *The Struggle for Atomic Control.* New York, Public Affairs Committee, 1947. 32 p. 20 cents. (Public Affairs Pamphlet No. 129.)

Proposed plans for international control, presented in terse, but readable style.

HECHT, SELIG. *Explaining the Atom.* New York, Viking Press, 1947. 205 p. $2.75.

The story of atomic research and an explanation of basic facts of atomic energy. Effectively illustrated with diagrams.

HIGINBOTHAM, W. A. *and* LINDLEY, ERNEST K. *Atomic Challenge.* New York, Foreign Policy Association, 1947. 63 p. 35 cents. (FPA Headline Series, No. 63.)

Brief, nontechnical presentation of information about atomic energy, proposals for international control, and efforts for international agreement (to late 1946).

JOHNSEN, JULIA E., *comp. The Atomic Bomb.* New York, H. W. Wilson Co., 1946. 335 p. $1.25. (The Reference Shelf, Vol. 19, No. 2.)

Articles from magazines, newspapers, conferences, etc., on history of the bomb, implications of atomic energy, control problems and peacetime benefits. Authors include Meitner, Cousins, Acheson, Einstein, Baruch, and others.

LANG, DANIEL. *Early Tales of the Atomic Age.* New York, Doubleday & Co., Inc., 1948. 223 p. $2.75.

Human interest stories connected with the development of the bomb, reprinted from *The New Yorker* magazine.

MASTERS, DEXTER, *and* WAY, KATHERINE, *eds. One World or None.* New York, McGraw-Hill Book Co., Inc., 1946. $1.

A series of readable articles discussing the implications of atomic energy developments, by persons who have participated in atomic research and applications.

NEWMAN, JAMES R. *and* MILLER, BYRON S. *The Control of Atomic Energy: A Study of its Social, Economic, and Political Implications.* New York, Whittlesey House, 1948. 434 p. $5.

An analysis of the Atomic Energy Act of 1946. Implications for industrial uses, patents, and inventions, control of information, military applications, and international agreements are discussed. Bibliography. Useful as source of information for special reports.

POTTER, R. D. *Young People's Book of Atomic Energy.* New York, Robert M. McBride & Co., 1946. $2.50.

A simple discussion of the basic facts of atomic energy.

STOKLEY, JAMES. *Electrons in Action.* New York, McGraw-Hill Book Co., Inc., 1946. $3.

Presents basic facts involved in atomic energy use, and its applications in various areas.

UNITED STATES ATOMIC ENERGY COMMISSION. *Fourth Semiannual Report.* Washington, U. S. Government Printing Office, 1948. 192 p. 35 cents.

Basic information on uses being made of radioisotopes in medical, agricultural, and other research.

Further Leads for Teachers

CRARY, R. W.; EVANS, H. M.; GOTLIEB, A.; *and* LIGHT, I. *The Challenge of Atomic Energy.* New York, Bureau of Publications, Teachers College, Columbia University, 1948. 92 p. 90 cents.

A resource unit and guide for teachers and group leaders. Adaptable for science or social studies classes at the senior high school level. Learning experiences and bibliography.

LIGHT, ISRAEL. *Annotated Bibliography on Atomic Energy.* New York, Bureau of Publications, Teachers College, Columbia University, 1947. 29 p. 35 cents.

About 257 references, organized by type of publication, with cross-references by topics. Useful for teachers and students in locating materials on special topics.

Audio-Visual Materials

Sound Films

The films now available tend, for the most part, to approach problems of atomic energy from the "fear" angle. In using such materials teachers may want to point out the other, more hopeful side of atomic energy developments. Plans are being initiated for the development of a series of films which will present more balanced coverage of atomic energy problems. New films may be available by fall, 1949, and together with those now available should present a better rounded group of materials.

Atomic Energy. 11 min. 16 mm. sd. 1947. Encyclopaedia Britannica Films, Inc. $50 with 10 percent discount to schools.

An introduction to principles of atomic energy. No reference to political problems involved in control. Useful for either science or social studies classes where a comprehensive unit is being studied.

Atomic Power. 19 min. 16 mm. sd. 1946. March of Time. $55.

Traces research in atomic energy from Einstein's work in 1905 through the development of the bomb and its use in World War II.

One World or None. 9 min. 16 mm. sd. 1946. Film Publishers. Rental $2.

Through animated drawings and live-action shots, film presents five concepts: There is no secret so far as basic principles are concerned; modern bombs would do far more damage than was done

at Hiroshima; any nation today is vulnerable to atomic weapons; there is no effective defense; atomic weapons reach a new high in destructiveness. Filmstrip also available.

Operation Crossroads. 27 min. 16 mm. sd. U. S. Navy. Free loan, on application to public information office in all naval districts, or to Motion Picture Section, Division of Public Information, Navy Department, Washington, D. C.

Shots of the Bikini test (1946).

A Tale of Two Cities. 20 min. 16 mm. sd. U. S. Signal Corps. Free loan, on application to the Signal Officer in local army area.

Shots of the bombings of Hiroshima and Nagasaki.

Church in the Atomic Age. 20 min. 16-mm. sd. Distributed by Film Program Services, 1173 Avenue of the Americas, New York, N. Y.

Reviews bombing of Hiroshima and Nagasaki; raises question of moral justification of its use; propounds question whether war today can be justified.

Filmstrips

Atomic Energy and the United Nations: Problems of International Control. 88 frames. United Nations, Department of Public Information, Lake Success, N. Y. 15 min. Free.

Proposals for international control currently before the United Nations. Accompanying commentary.

How to Live With the Atom. 63 frames. Film Publishers, Inc., 25 Broad Street, New York 4, N. Y. 15 min. With speech notes, \$3. 16" transc., narration and music, \$5.

Points out through cartoons that basic principles are not secret, there is no defense against the bomb, nations must develop controls to "live with the atom."

Records and Transcriptions

Deadline for Living. 14 min. transcription. National Education Association, 1201 Sixteenth Street NW., Washington, D. C. \$10.

What warfare can mean, and what the average citizen can do to avert it before we reach the "deadline."

Peacetime Uses of Atomic Energy. 20 min. Two 12" (78 r. p. m.) records. Lewellen's Productions, 8 South Michigan Avenue, Chicago 5, Ill. \$12.50.

Produced for classroom use, with technical advice by Dr. Glenn Seaborg and narration by Neil Hamilton. Set includes teacher's guide and 50 copies student guide. A comparison set is entitled *The Atomic Bomb.*

ATOMIC ENERGY PROGRAM

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these materials for making weapons, there is a parallel chain of research operations to discover new fundamental knowledge and to apply it for many purposes. This side of the atomic energy program is financed by funds appropriated to the Commission, but carried on again in the main by privately operated agencies—universities, colleges, research institutes, industrial laboratories. There are 5 great centers of the program. These are Brookhaven National Laboratory, Long Island, operated by 9 of the leading universities of the northeastern United States; Oak Ridge National Laboratory, operated by Carbon & Carbide Chemicals Corp., with membership of 19 southern and southwestern universities in the affiliated Oak Ridge Institute for Nuclear Studies; the Argonne National Laboratory, near Chicago, operated by the University of Chicago with 30 midwestern universities represented on its Board of Governors; the Radiation Laboratory at the University of California, Berkeley; and the Ames Laboratory at Iowa State College, Ames, Iowa. The great facilities at these places—the largest cyclotrons and other particle accelerators in the world, the only research reactors in the United States, and associated special laboratory facilities—are available to all universities, colleges, and industrial concerns meeting certain qualifications.

Besides these national laboratories, the Commission finances facilities and operations at nearly 100 other points under direct contract to carry on specified fundamental and applied research.

Additionally, the Commission is trying to increase the number of people trained in the nuclear and associated sciences through a system of fellowships running at the rate of 3 million dollars a year, through the operations of medical and biological training centers at four points, and through isotope users' schools at Oak Ridge.

Of great importance, the Commission is the sole source of the radioactive isotopes—made in the nuclear reactor pile at Oak Ridge—which have worked a large advance in dozens of lines of research. These are claimed to be the most important new research tools since the invention of the microscope. They are in use by more than 1,000 individual universities and industrial and agricultural laboratories. The number of shipments is doubling each 6 months.

New research work is projected or under way for the most costly and most useful—if it succeeds—project of all. This is the development of reactors which will turn the heat and energy from nuclear reaction into electrical energy for powering our factories, lighting our homes, and driving ships and airplanes of the future. Reactors for experiments in the production of central station electricity are in the late planning stages at Schenectady, N. Y., where the General Electric Co. operates the Knolls Atomic Power Laboratory. The middle stages of design on reactors for propelling naval vessels are being undertaken by the Westinghouse Electric Corp.

In brief, the atomic energy enterprise of the people of the United States, girdling half the globe, reaching into nearly every State and thousands of industrial plants and academic and industrial laboratories, is proceeding with a program to develop atomic energy. The purposes are to protect the common defense and security and to apply atomic energy for making usable power to lift the burden of drudgery from men's days, for research to advance the arts of healing and the arts of production of food and of industrial goods, and for the addition of new knowledge to the store available to man.

SCHOOL TAKES HOLD

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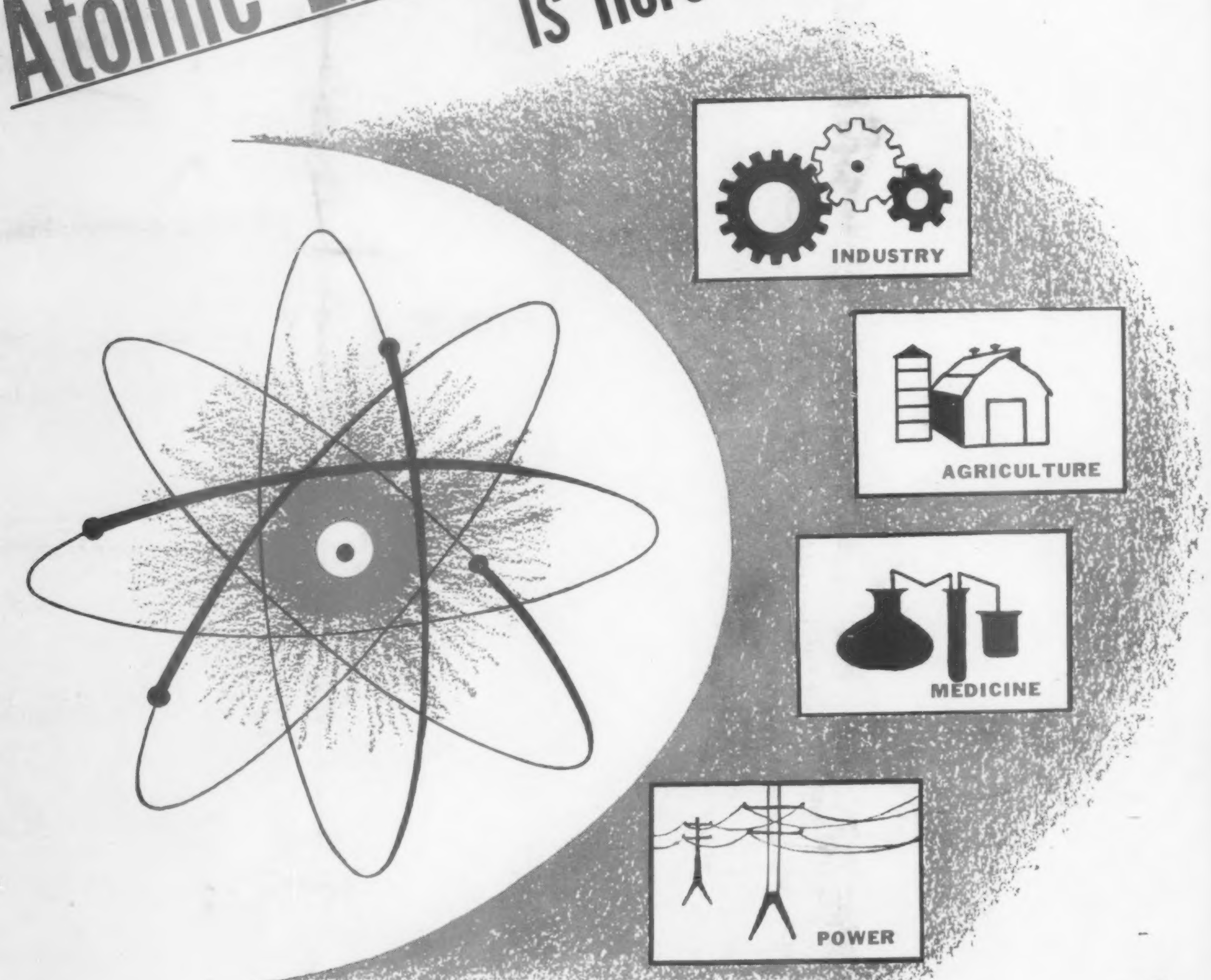
example, in cooperation with the State Department of Education, is sponsoring such a workshop next summer. A number of such workshops will be going on in New England at the same time. Specific information about those can be obtained from the New England Atomic Energy Workshop Committee, Harvard University Graduate School of Education. Teachers who participate in such workshops can lead in planning for the school's program of atomic energy education. (See Feb. 1, 1949, issue of HIGHER EDUCATION, published by the Office of Education, and later issues of SCHOOL LIFE, for further announcements.)

A faculty reading shelf is a good idea. If a faculty committee can spend perhaps \$30 for books and magazines, materials can be circulated among the staff, with committee recommendations for reading.

Another type of project was followed by the faculty of Highland Park, (Mich.) High School, which prepared a manual on atmoic energy education, including lists of learning materials and suitable activities.

Once a beginning has been made, student interest in most schools will cause atomic education to snowball.

Atomic Energy is Here to Stay



How we use it is the Business of every Citizen